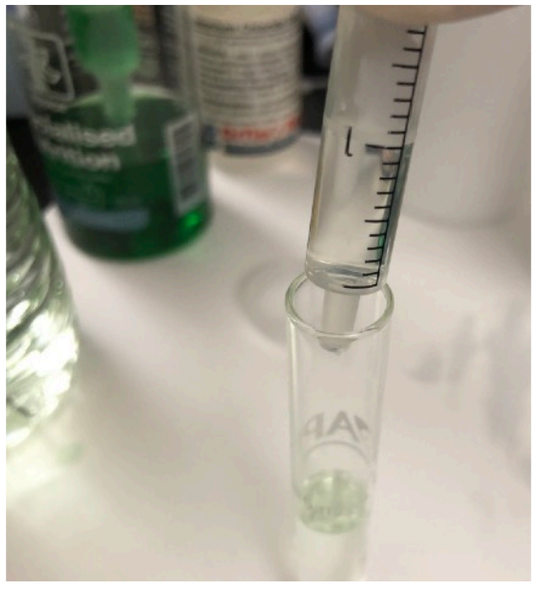
Ashank Singh

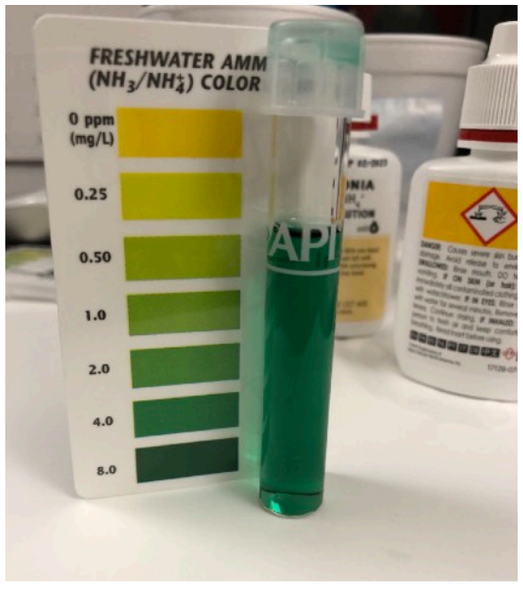
Portfolio

FISH BUDDY

Fish-keeping Simplified.

BACKGROUND





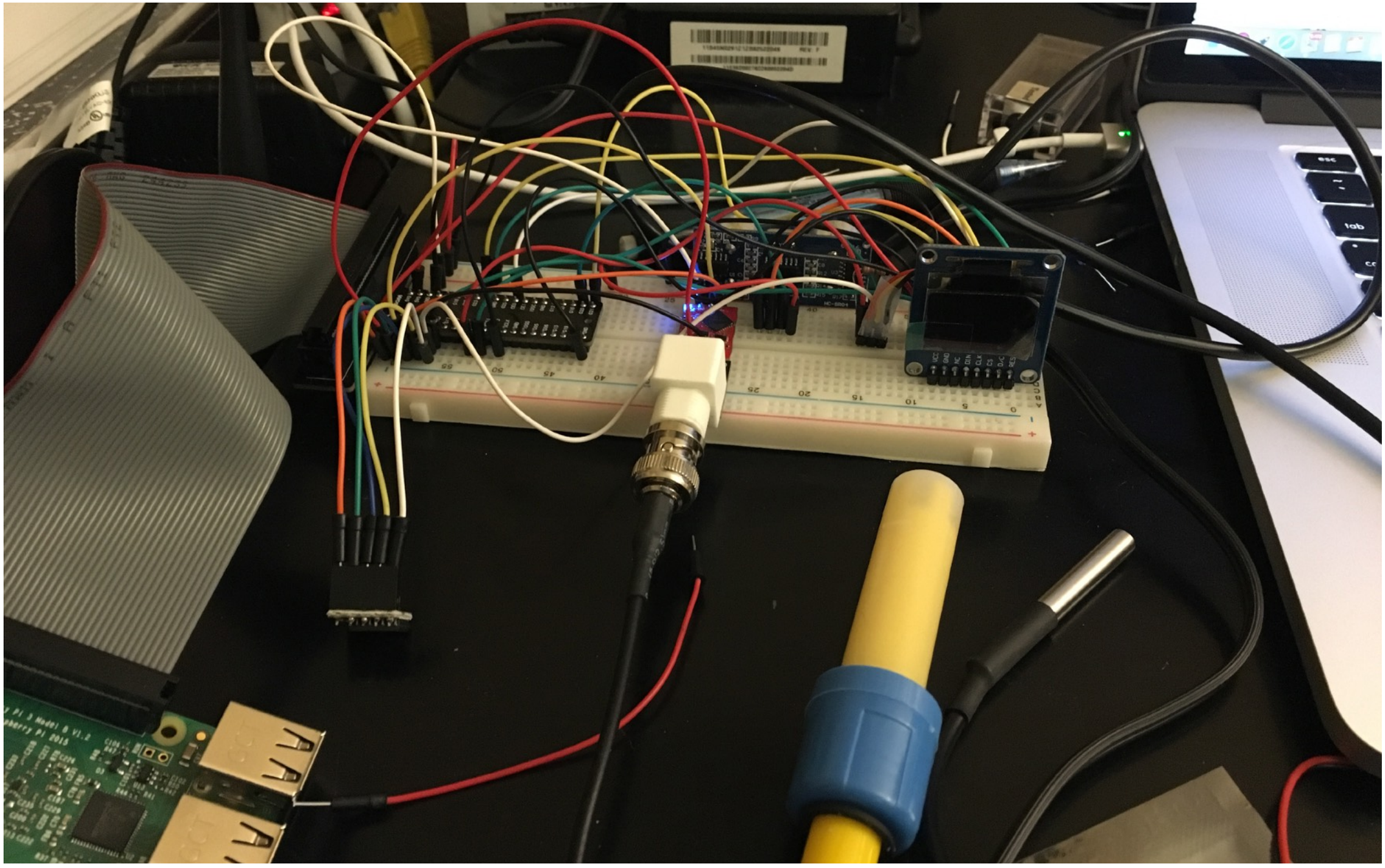
Aquariums are delicately balanced microecosystems. Success and failure hinges on many invisible factors.

pH, temperature, TDS (total dissolved solids), nitrate, and ammonia are a few parameters that aquarists frequently monitor.

Unchecked parameters can spell disaster for aquarium inhabitants. Emergency maintenance can quickly drive up costs in the aquarium hobby and in the $16 billion aquarium industry.

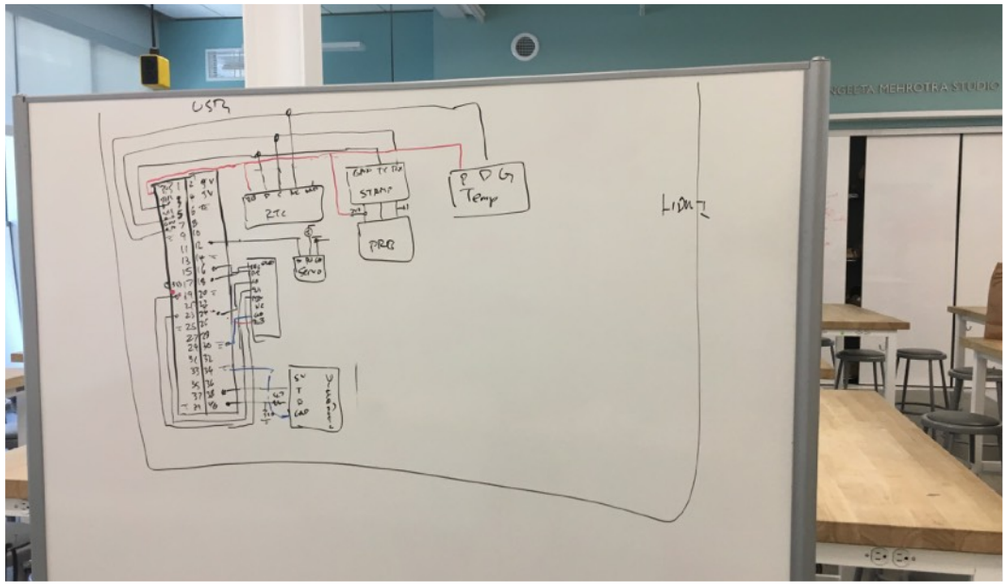
With busy lifestyles and the unforgiving nature of aquariums, more so if something is wrong with the tank, chances are one won't notice until it's too late!

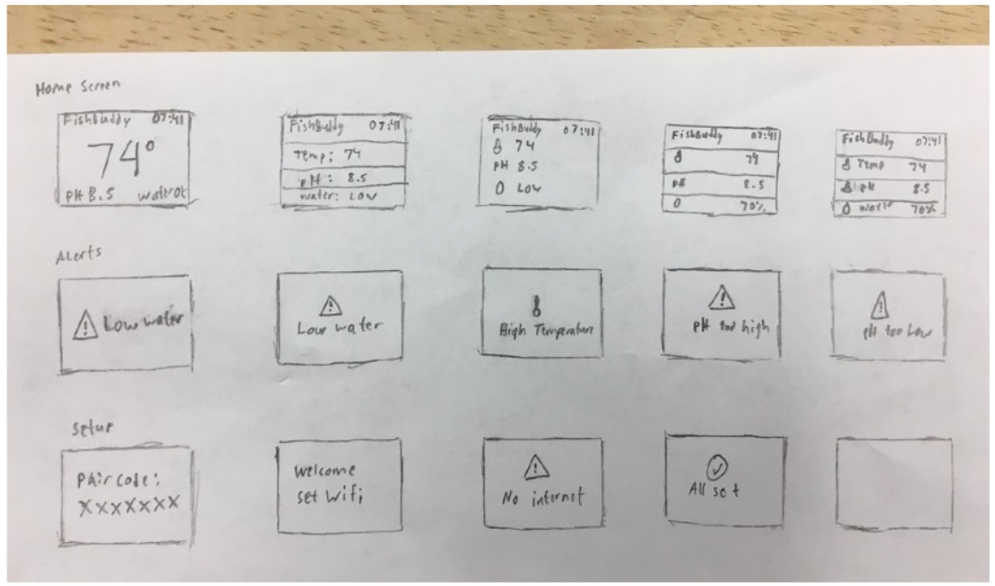
PROTOTYPING

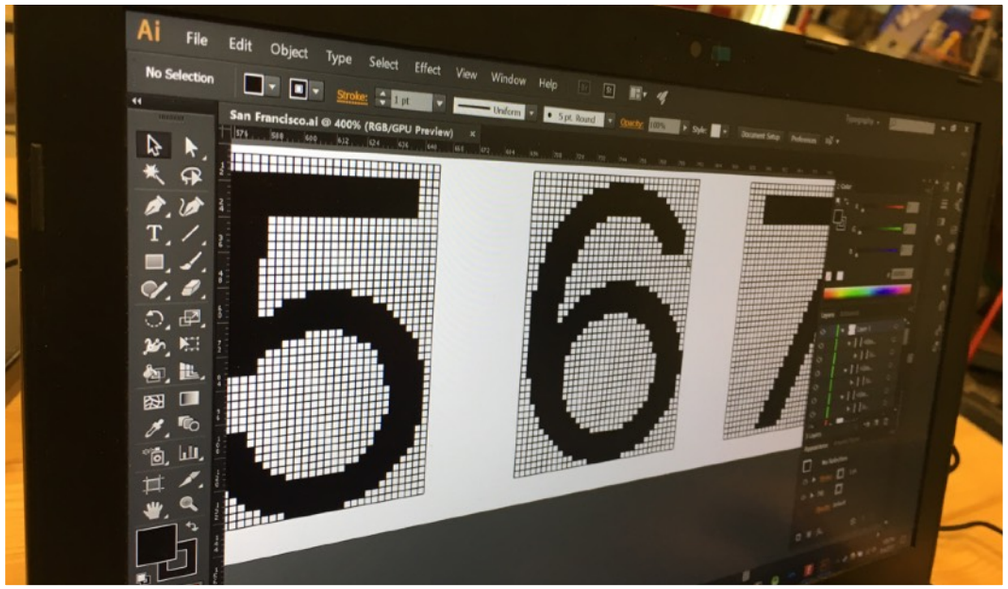


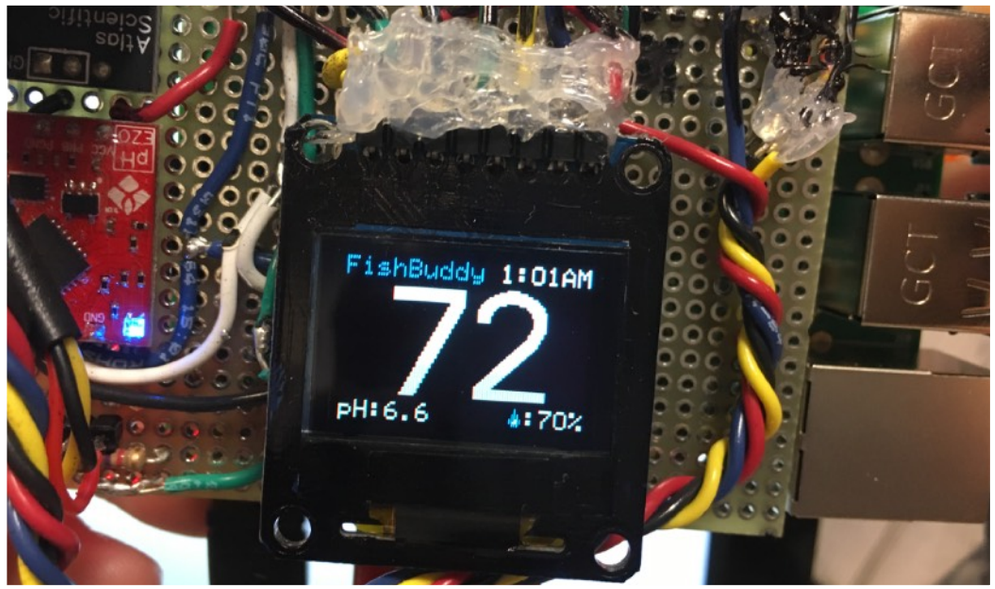
Following two weeks of evaluating users' needs, a cloud-connected approach to monitoring aquariums was necessary. Later prototypes incorporated a Raspberry Pi, a Real-time clock, an OLED display and an array of lab-grade sensors.

PROTOTYPING



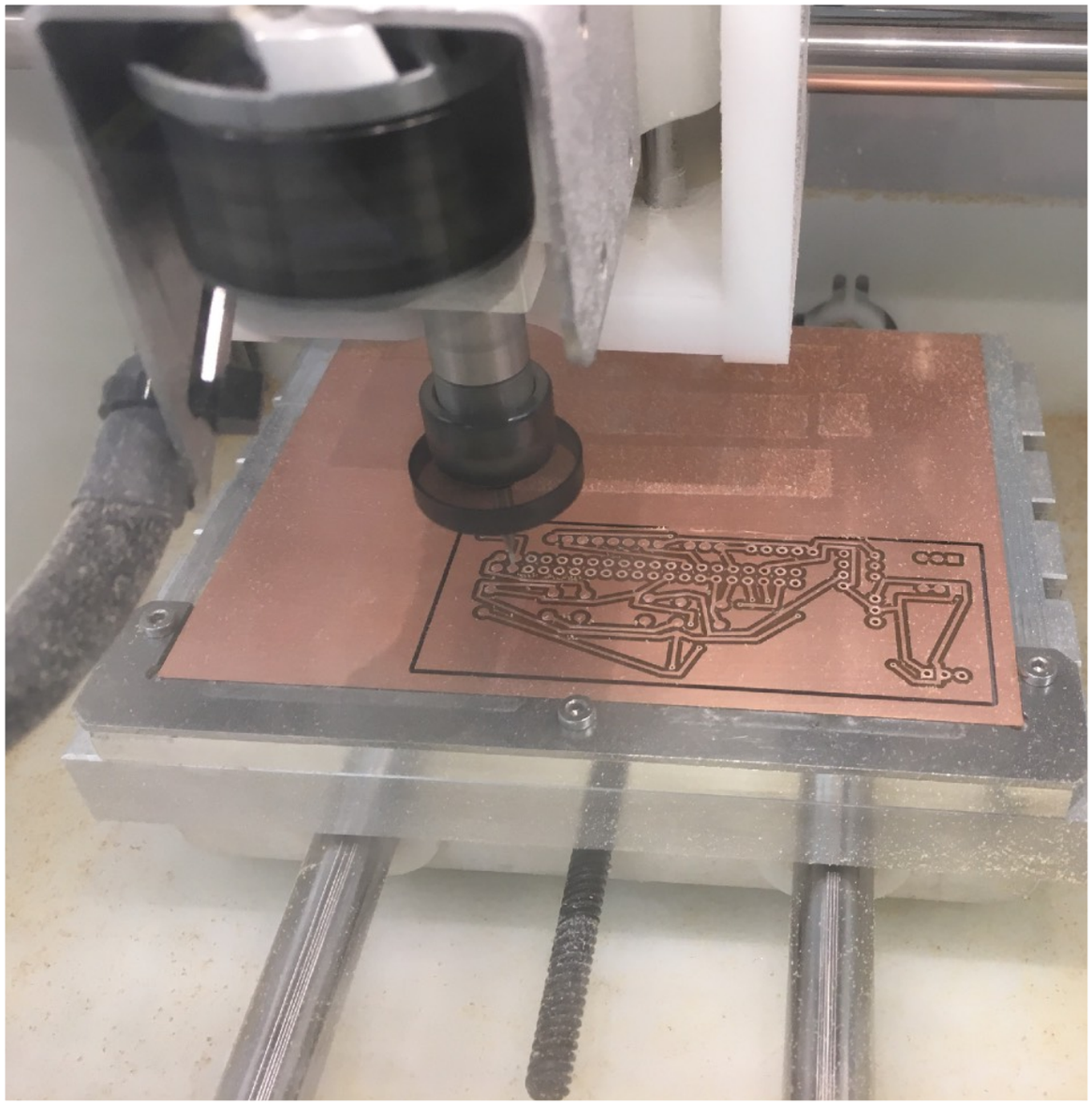


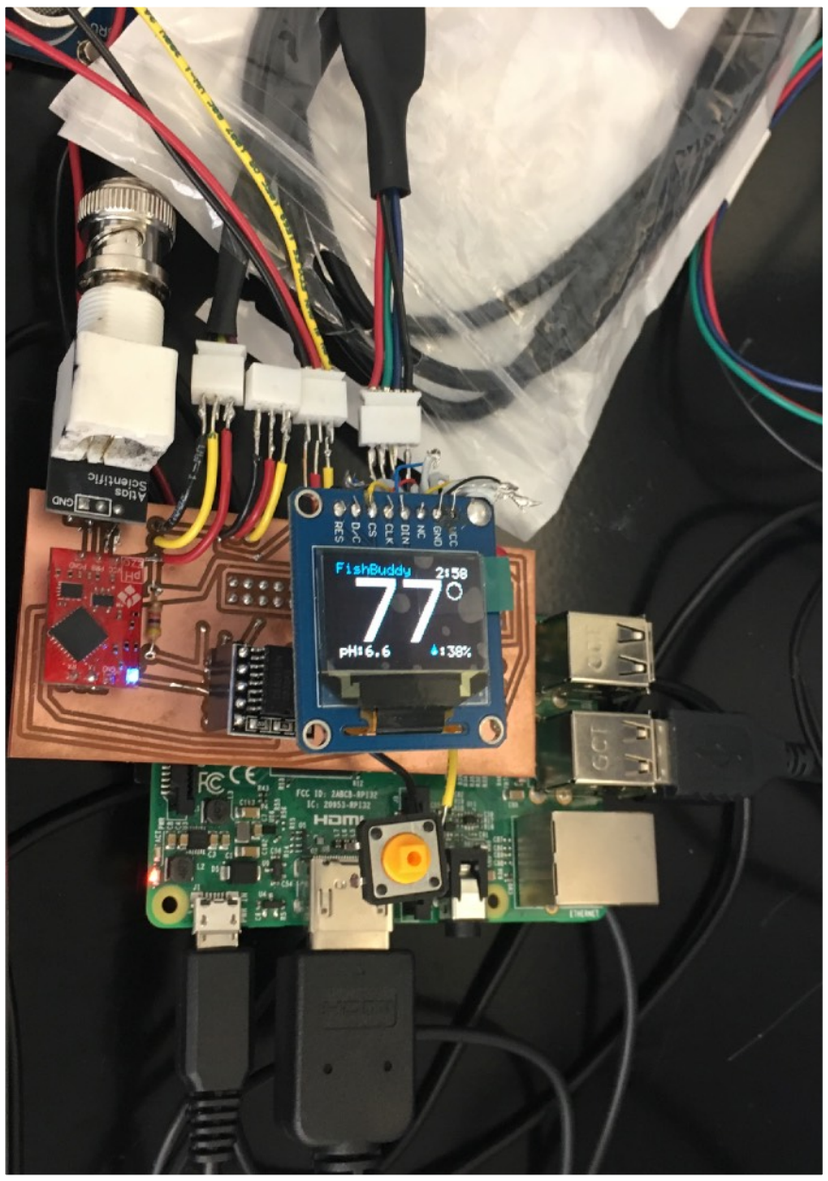




After finalizing the functionality of the device, miniaturization soon became a priority. Components were hand-soldered on a perfboard to reduce their footprint. The readability constraints of a 1 inch OLED display were addressed by designing a user interface optimized for the display's 128 x 64px resolution and by creating a custom Sans-serif font: FishBuddy Sans.

FABRICATION

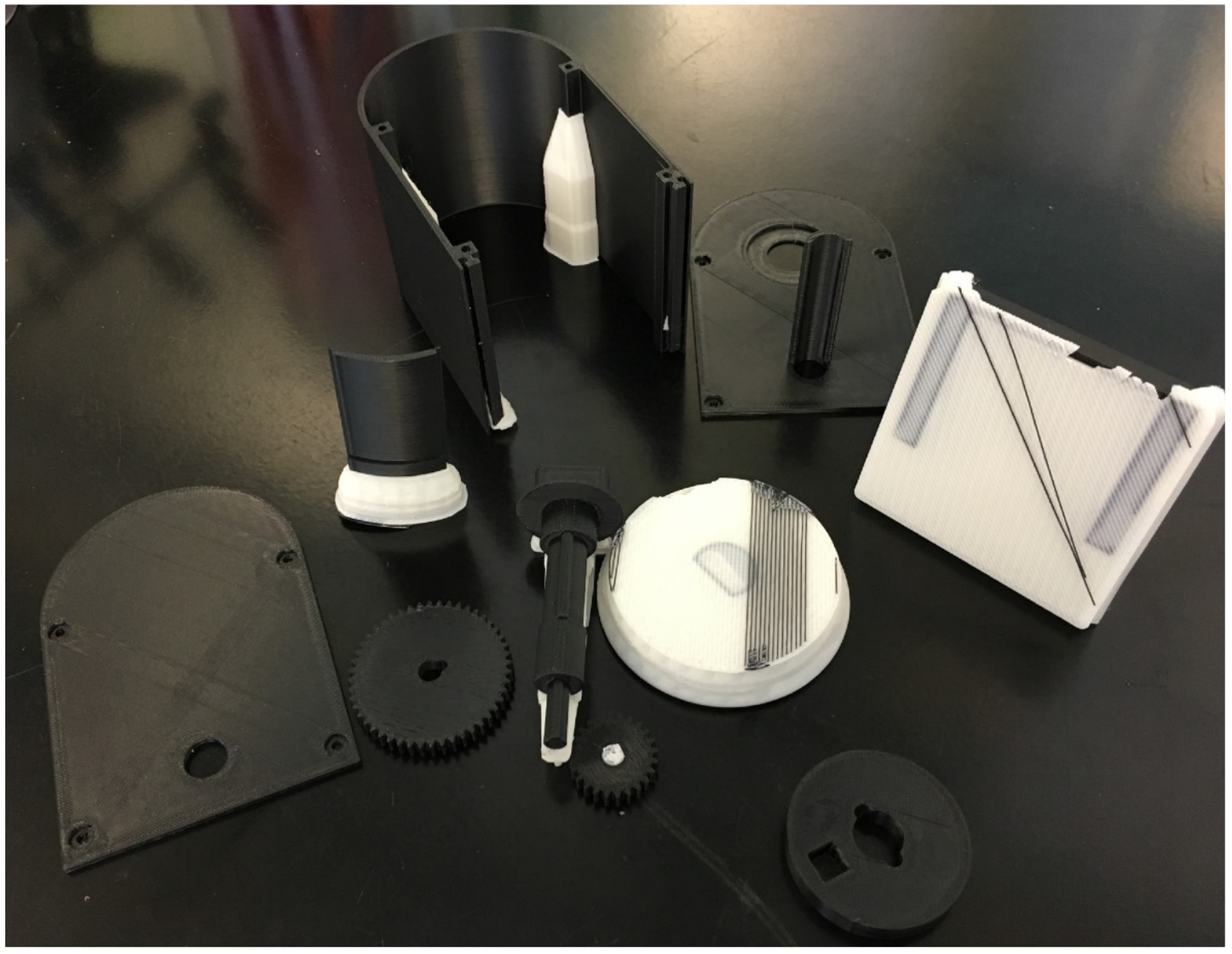




Hand-soldered perfboards could only go as far in the miniaturization of the electronics.

To fit the enclosure of the final prototype, a 2 layer copper PCB was milled using a CNC.

FABRICATION



A Stratasys Fortus 380mc was employed to print the enclosure and gear mechanisms of the feeding mechanism using ABS plastic with a tolerance of ± .127 mm. (The white pieces are NaOH-soluble support structures.)

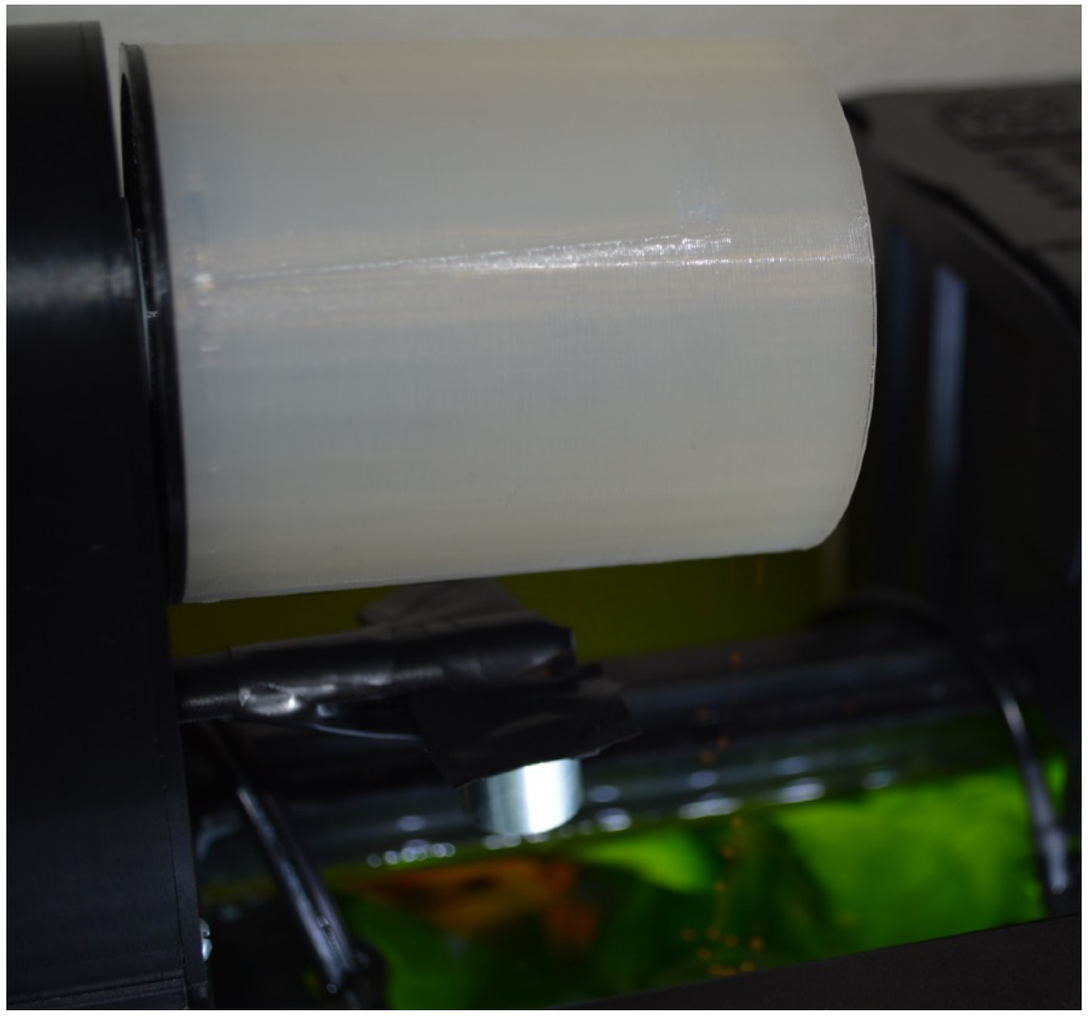
FINAL FORM

In its final form, FishBuddy is powered by a blackbox that functions as a server which streams the aquarium's vitals to a companion app. The blackbox analyzes water parameter trends and makes suggestions when it senses something wrong. It even sends emergency text messages to trusted conntacts. The blackbox also integrates with an adjustable feeding mechanism that only dispenses as much as the fish can eat within three minutes.

AN ECOSYSTEM IN HARMONY

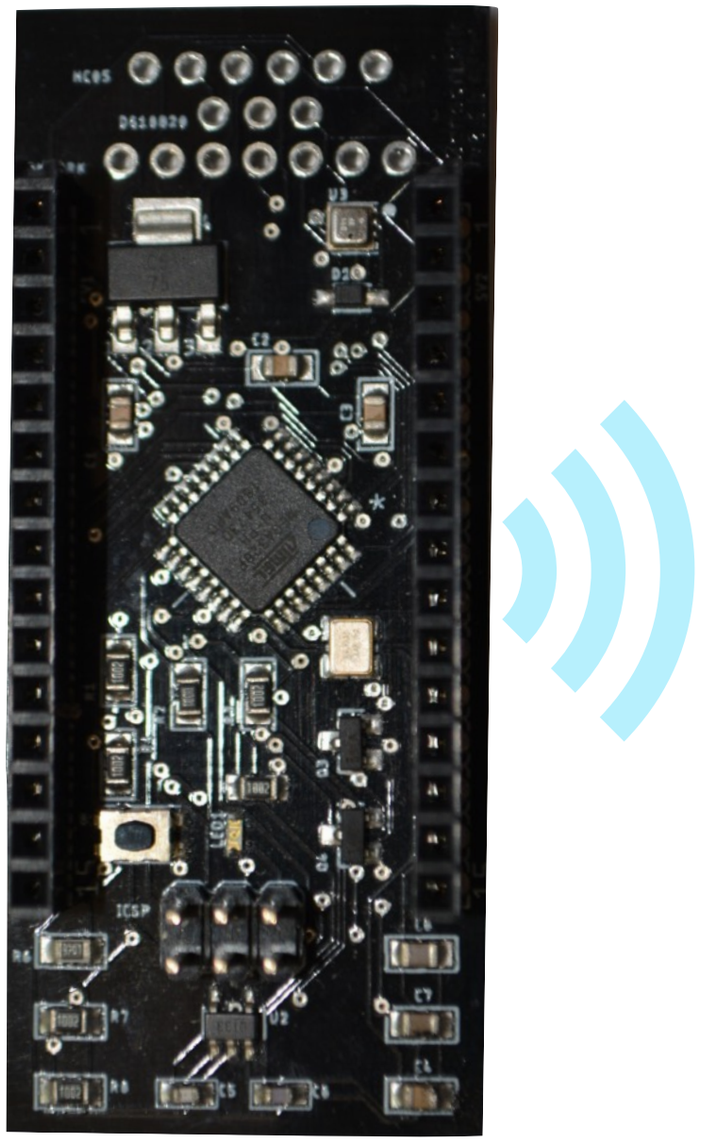
Combining a blackbox, a feeder and an iOS app, FishBuddy is an ecosystem in perfect harmony.

FISH-KEEPING, SIMPLIFIED.



FishBuddy lets its users rest easy as it keeps the fish fed and keeps a steady eye on the aquarium’s vitals.

In many ways, FishBuddy is the ultimate intersection of nature and technology.



SENSORLINK

BACKGROUND

Smart thermostats bridge HVACs with the digital world and use aggregated data to make decisions that reduce energy consumption.

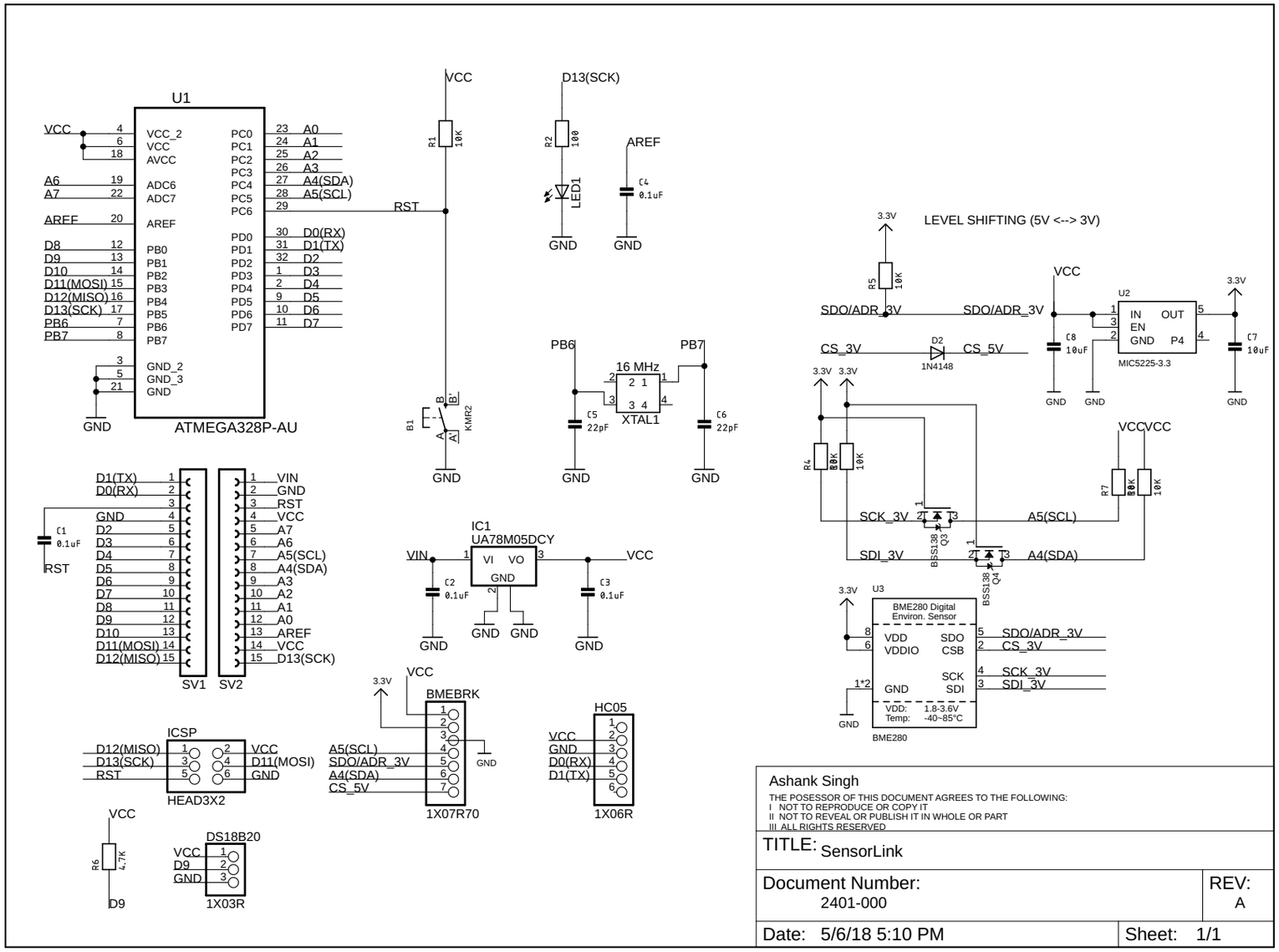
Frequently, a less than ideal placement of vents makes certain rooms less comfortable than the other rooms at home.

Humidity and temperature are the two factors that affect people's perception of comfort.

Current thermostats on the market only consider the room's temperature and fail to account for the humidity of each room.

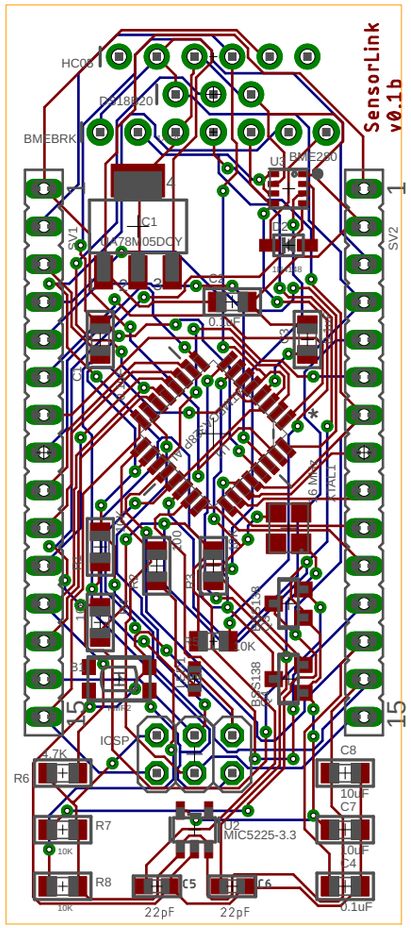
Clearly, there needs to be a way to augment existing thermostats with humidity data from each room!

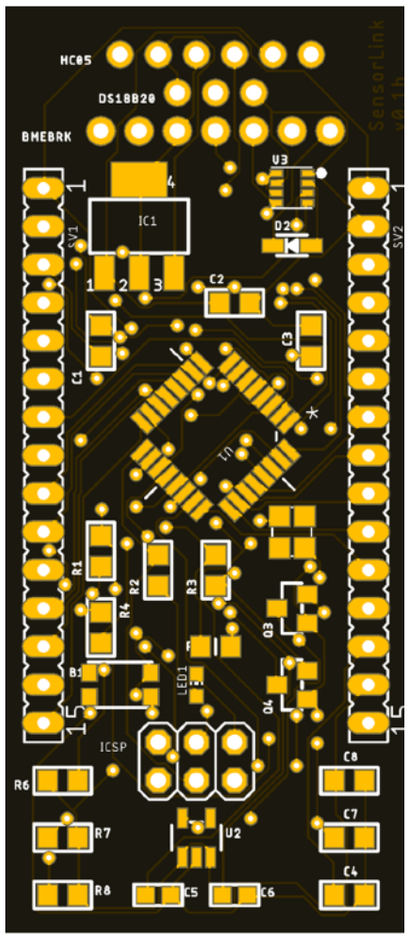
DESIGN

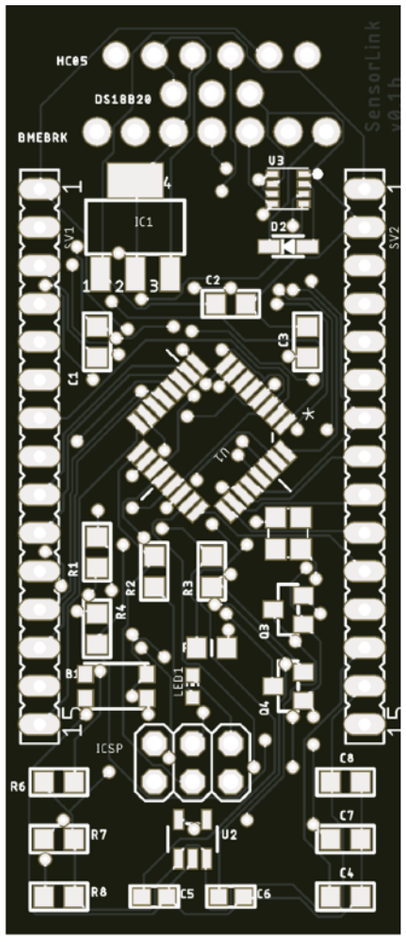


Simply put, all wireless sensors comprise of a MCU, a battery, a sensor, and a radio of some sort. After disassembling and evaluating the components of wireless temperature sensors as well as an iPhone 6S, I discovered the degrees to which sensors are miniaturized and set out to design and build my own board. I chose the Bosch Sensortech BME 280 and worked my way up to build a board to augment thermostats with additional humidity data.

DESIGN

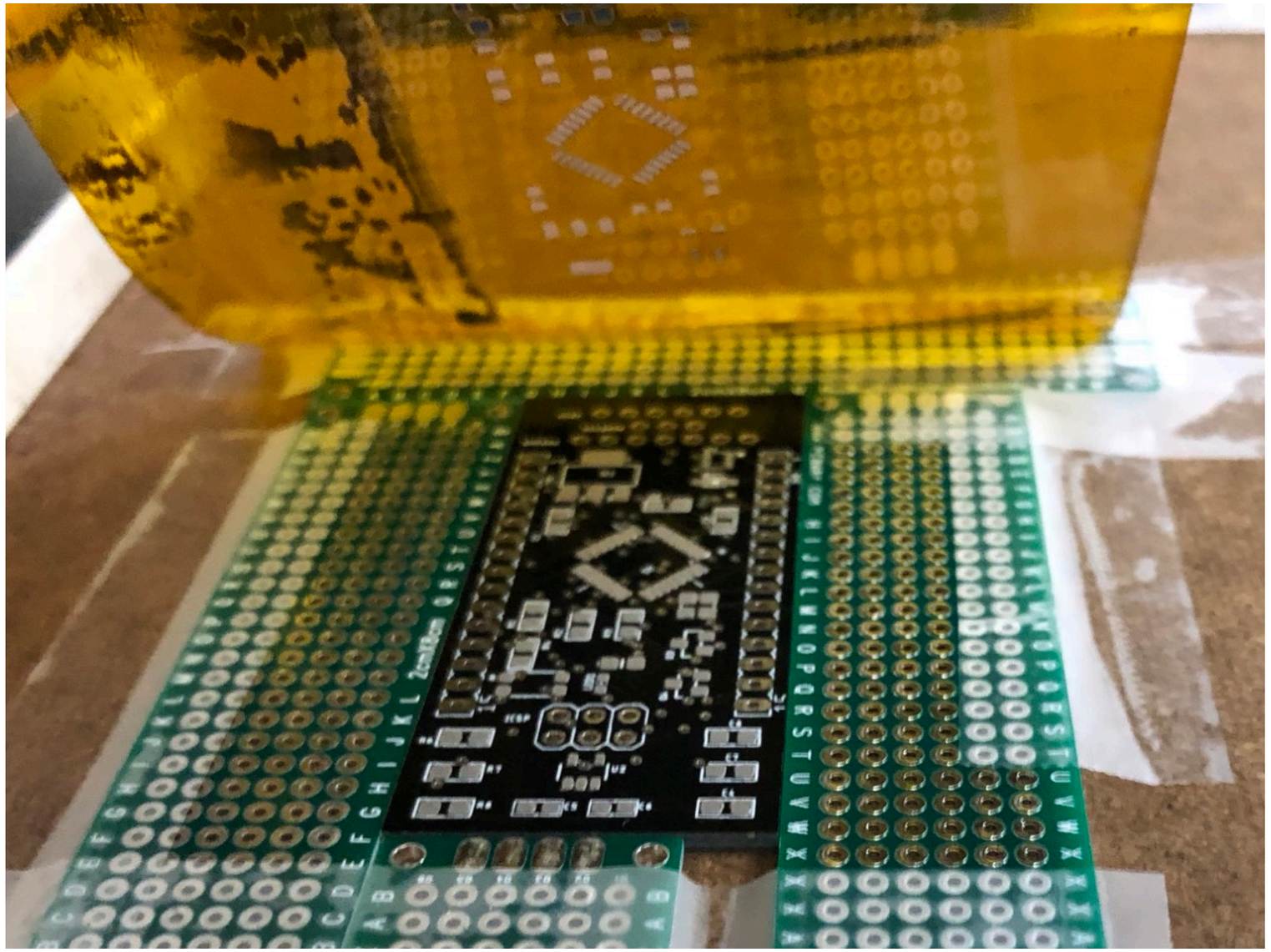






After placing over 32 components on the PCB, I routed the components in a manner that would reduce crosstalk and also reduce thermal interference to the BME 280. Considering this chip is prone to self-heating, to dissipate heat, I had two options: ask the manufacturer to laser drill thermal vias under the chip's footprint, or increase the size of the solder pads. In an effort to reduce cost, I chose the latter. To reduce the production cost even further, I chose HASL (pb free) over ENIG surface treatment. By negotiating with overseas vendors, the cost of each PCB was under $35.

FABRICATION

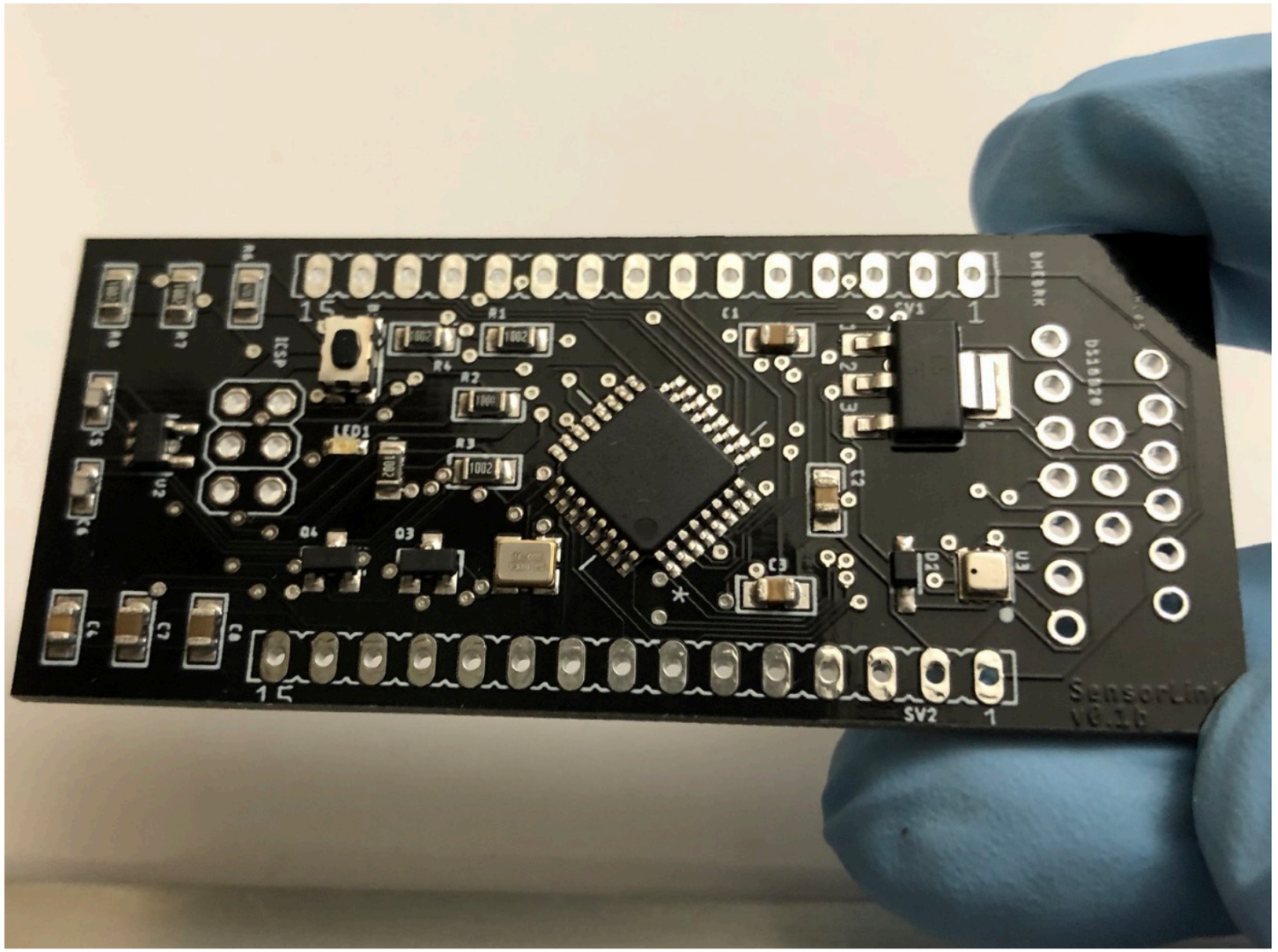


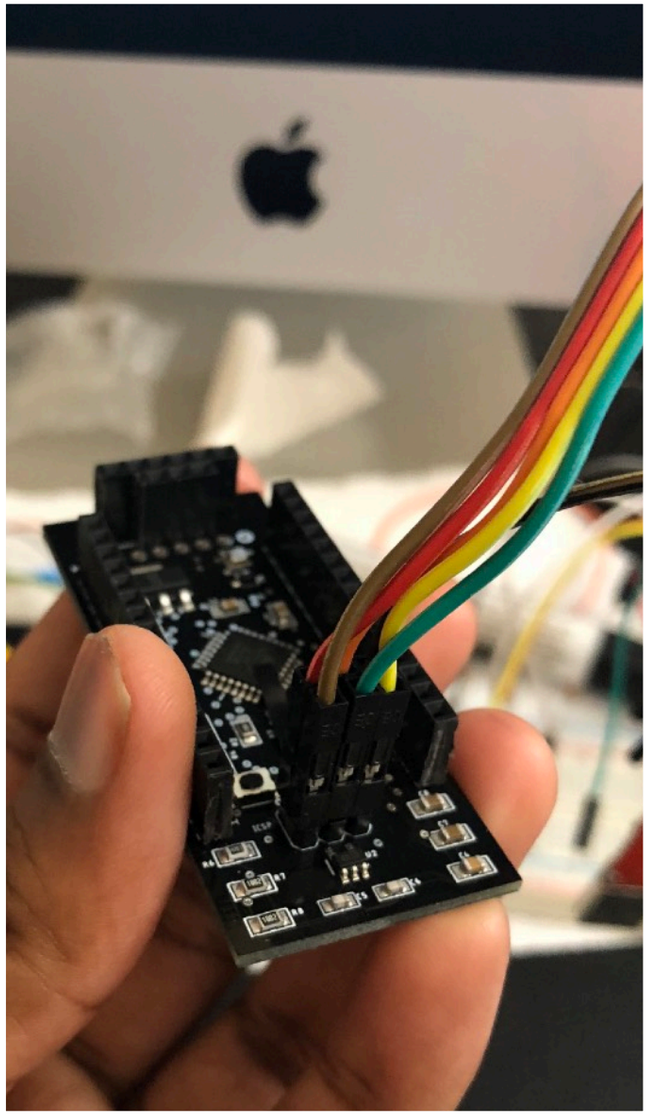
Due to the number of small surface mount components on the board. It was not possible to hand solder without having bridged pins. Therefore, a laser-cut polyimide solder paste stencil was used to prep the board for reflow soldering.

FABRICATION

As an experiment, instead of using a normal reflow oven, I modified a toaster oven to heat the boards to the correct solder profile for the components.

VALIDATION



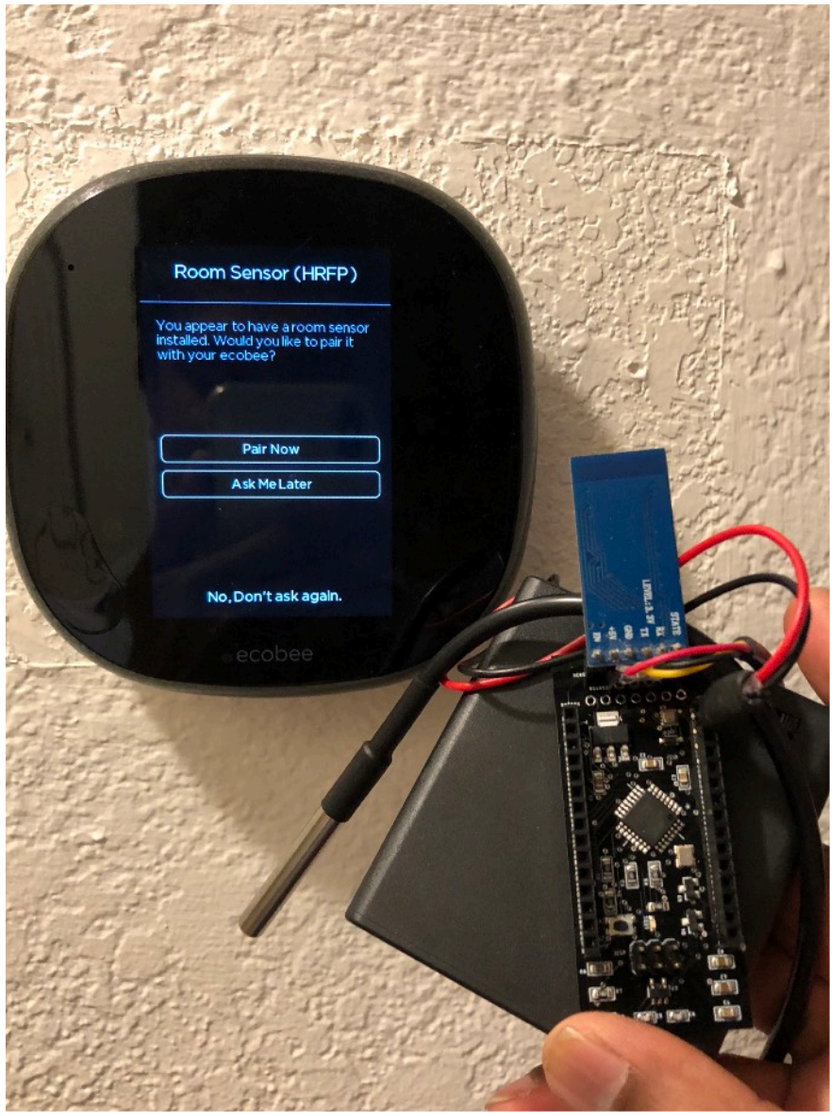


Fresh out of the oven, SensorLink was ready for its first test: flashing a bootloader via its ICSP pins.

VALIDATION

To test out the components on the board, custom firmware was developed to read battery levels, temperature, air-pressure, and most importantly, humidity.

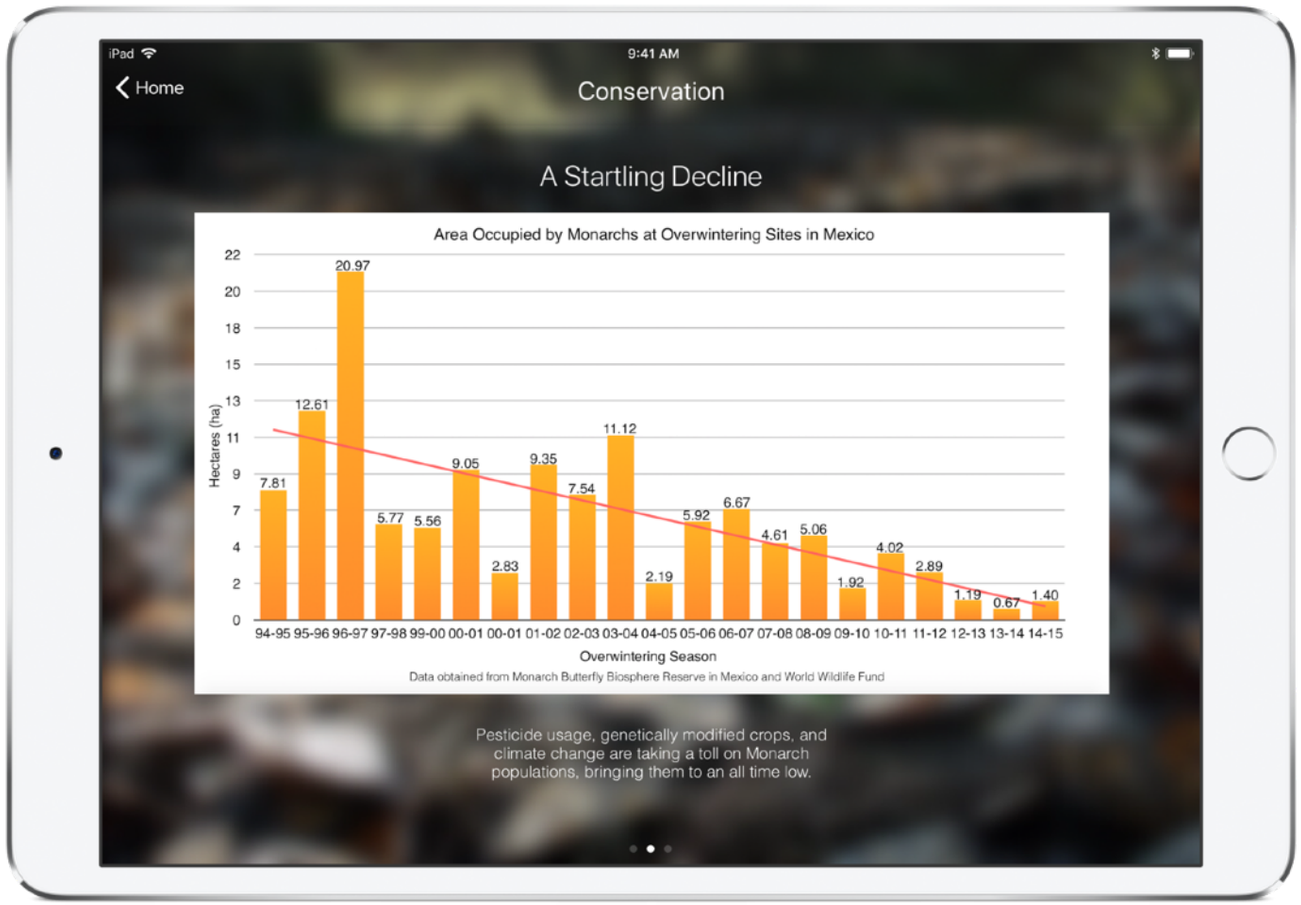
PAIRING



After disassembling several ecobee room sensors and examining their behavior, I was successful at reverse engineering their wireless communication protocol. I finally managed get the ecobee thermostat to recognize and pair with Sensorlink via a Bluetooth module. Now, the thermostat displays an average of all the humidities in the rooms.

MONARCH APP

BACKGROUND



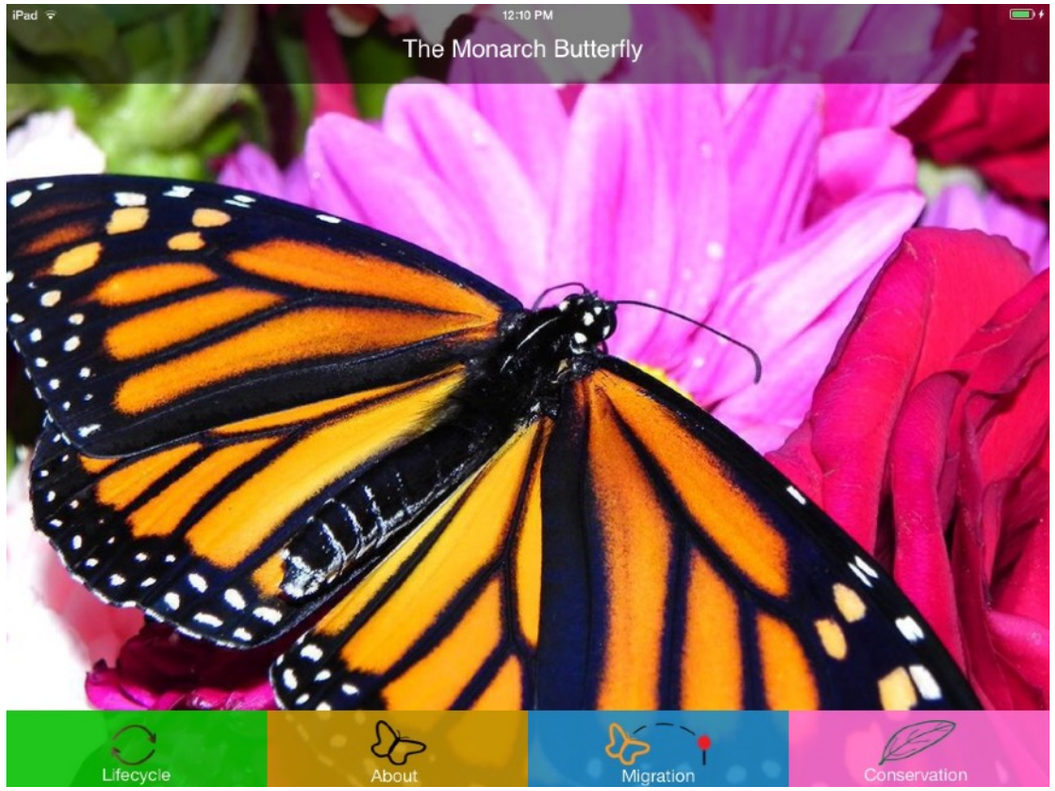
Monarchs are a species under threat.

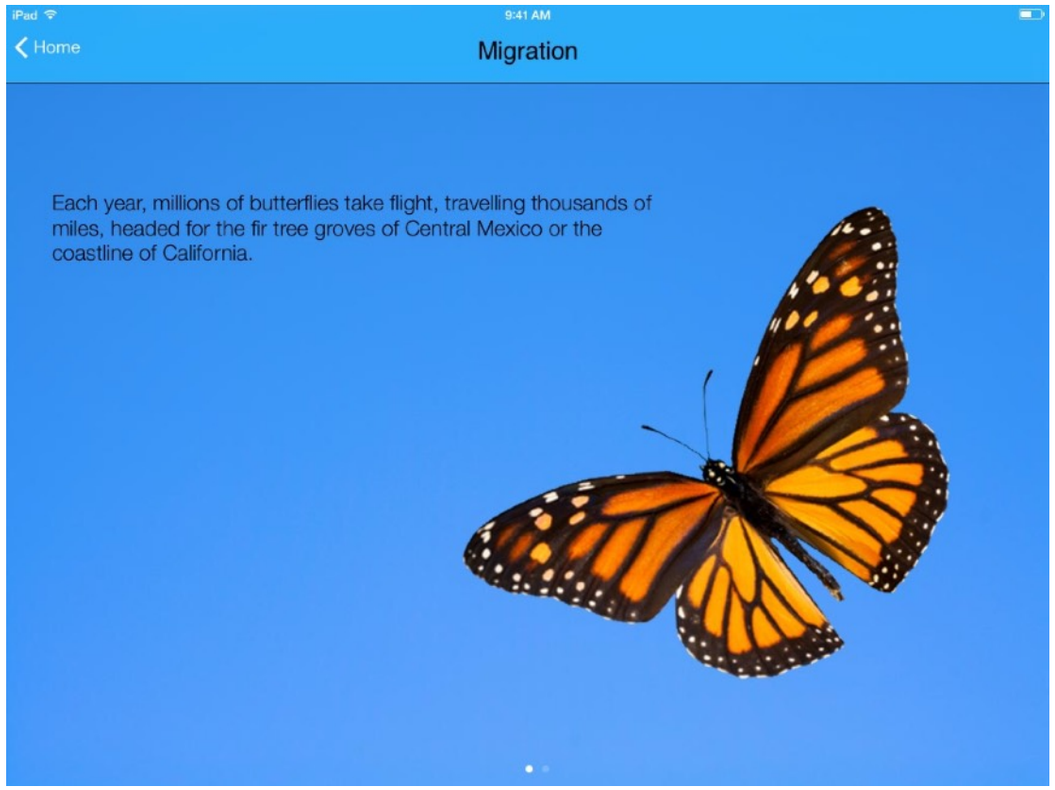
Human activities coupled with a changing climate have resulted in a steep decline of the butterfly's population.

In an effort to raise awareness about the issue, I developed an educational iPad app.

Featuring original photography, Monarch App illustrates the life history and the remarkable migration of the butterflies with the swipe of a finger.

OLD DESIGN



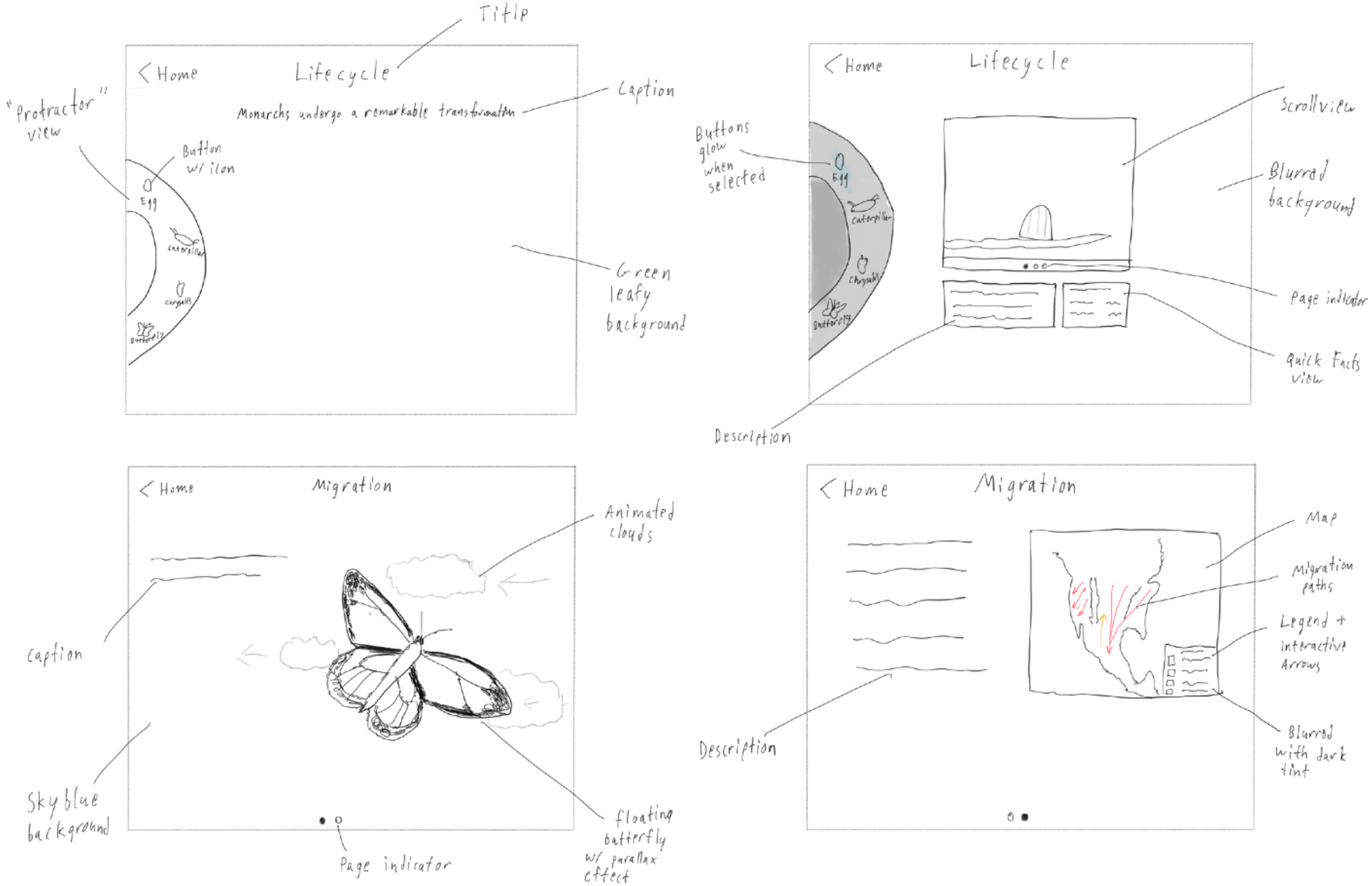


Monarch App has evolved. Its former design comprised of a tabbed home menu along with a static home image.

The metaphor of a custom tab bar at the bottom of the home screen, provided the wrong affordance to users who felt that the bar would persist throughout the app's screens.

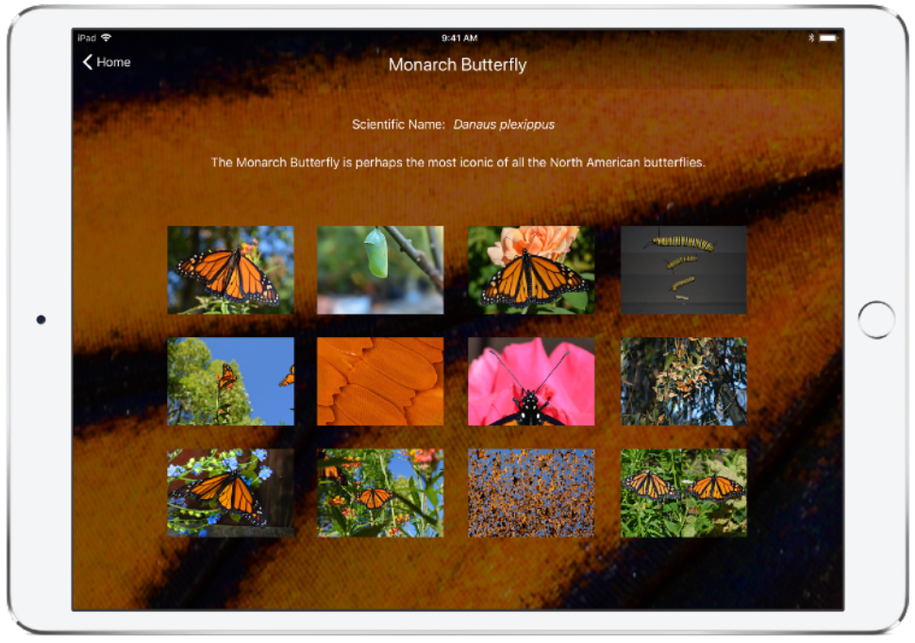
After observing users and getting feedback at WWDC 2014, I chose to redesign the app from ground-up to create a more interactive experience.

REDESIGN



After sketching a few new screens similar to these, users were invited to tap on the icons. I observed them interacting with low fidelity prototypes and this allowed me to gain enough insights into their behavior to develop a better user interface. Finally, before investing in writing code, I made interactive app prototypes in Keynote to gain a better understanding of how the users would respond to animations.

NEW DESIGN



Incorporating accelerometer motion, Monarch App creates a perception of depth with parallax effects. Monarch App has truly undergone a metamorphosis of its design.